Chapter 8
Multi-Criteria Approaches in Selecting Optimal Vehicle-to-Vehicle Communication Protocols

N. Anitha
https://orcid.org/0000-0003-0381-2437
Periyar University Centre for Postgraduate and Research Studies, India

Mohit Tiwari
https://orcid.org/0000-0003-1836-3451
Bharat Vidyapeeth's College of Engineering, India

Shaik Moinuddin Imran
Sri Venkateswara Institute of Technology, India

Y. Monikarchana
Mohan Babu University, India

Manish Kumar Thakur
Acharya Institute of Technology, India

M. Clement Joe Anand
https://orcid.org/0000-0002-1959-7631
Mount Carmel College, India

ABSTRACT

Communication protocols are guidelines governing the transmission of data between the entities of the vehicular networks. These protocols play a crucial role in enabling optimal connectivity, ensuring safety and traffic management. The effective functioning of the V2V network depends on the right choice of communication protocols, as the mismatch in selection results in incompatibility, performance degradation, congestion, and other security issues. This chapter focuses primarily

DOI: 10.4018/979-8-3693-6422-2.ch008

on the intervention of a multi-criteria approach in making an optimal selection of the communication protocols used in the V2V network. The decision-making problem comprises the alternatives namely IEEE 802.11p, Cellular-V2X, Dedicated Short-Range Communication (DSRC), LTE-V2X, IEEE 1609.x, and ITS-G5. The criteria considered are Compatibility, Security, Data Rate, Range, Scalability, and Spectral Efficiency. Different MCDM approaches such as AHP, Entropy method, and FUCOM are applied to this linguistic decision matrix to obtain the criterion weights, and methods such as COPRAS, SMART, and MAIRCA are applied in ranking the alternatives. A comparative analysis is made to determine the validity of the criterion weights and ranking results. These combined MCDM approaches shall be applied to other decision-making scenarios of vehicular networking to design optimal solutions.

1. INTRODUCTION

The vehicular communication networks are highly significant in enhancing the smart transportation system. The vehicular network efficiency is purely dependent on the kind of communication protocols. There are several kinds of vehicular communication networks namely V2V, V2I, V2G, V2X which deal with information exchange between the entities namely the vehicles, infrastructure, grid, and other components. The decision-makers have to make the optimal choice of these protocols to ensure the efficient functioning of the vehicular networks. Multi-criteria decision-making methods are the best choice to make an optimal selection of communication protocols. This decision-making framework comprises alternatives criteria and suitable methods of making optimal decisions. This framework comprises two predominant phases one is the computation of criterion weights and the other is the ranking of alternatives.

Multi-criteria decision-making methods comprise several methods to find feasible solutions to the problems. The optimal choice of communication protocols is a basic requisite for enriching and enhancing the network efficiency. The protocols that are generally considered are IEEE 802.11p, Cellular-V2X, Dedicated Short-Range Communication (DSRC), LTE-V2X, IEEE 1609.x and ITS-G5. These protocols possess different attributes and the decision-makers choose either of the protocols based on their requirements. However, the optimal choice of these protocols and rankings of the same is essential at times of drawing decisions on vehicular efficiency. This research work develops a decision-making model using multi-criteria approaches with communication protocols as alternatives and the criteria of Compatibility, Security, Data Rate Range, Scalability, and Spectral Efficiency.